CLAIMS

1. Apparatus for driving current in a power circuit of a medical device inserted into a body of a subject, the apparatus comprising:

a power transmitter, which is adapted to generate, in a vicinity of the body, an electromagnetic field having a predetermined frequency capable of inductively driving the current in the power circuit; and

a passive energy transfer amplifier, having a resonant response at the frequency of the electromagnetic field and adapted to be placed in proximity to the medical device so as to enhance the current driven in the power circuit by the electromagnetic field.

2. The apparatus according to claim 1, wherein the passive energy transfer amplifier comprises a coil and a capacitance, which are coupled so as to define a resonant circuit having the resonant response at the frequency of the electromagnetic field.

3. The apparatus according to claim 1, wherein the passive energy transfer amplifier is adapted to be implanted in the body in proximity to the medical device.

4. The apparatus according to claim 3, wherein the medical device comprises a sensor for use in association with an orthopedic implant, and wherein the passive energy transfer amplifier is incorporated in the orthopedic implant.

5. The apparatus according to claim 1, wherein the passive energy transfer amplifier is adapted to be fixed externally to the body in proximity to the medical device.

6. Apparatus for use in an invasive medical procedure, comprising:

a wireless medical device, which is adapted to be inserted into a body of a subject, the device comprising a power circuit, which is adapted to be driven inductively by a radio-frequency (RF) electromagnetic field so as to provide operating energy to the device;

a power transmitter, which is adapted to generate the RF electromagnetic field in a vicinity of the body; and

a passive energy transfer amplifier, which is adapted to be placed in proximity to the medical device so as to enhance inductive driving of the power circuit of the wireless medical device by the RF electromagnetic field.

7. The apparatus according to claim 6, wherein the power transmitter is adapted to generate the RF electromagnetic field at a predetermined frequency, and wherein the passive energy transfer amplifier has a resonant response at the predetermined frequency.

8. The apparatus according to claim 7, wherein the passive energy transfer amplifier comprises a coil and a capacitance, which are coupled so as to define a resonant circuit having the resonant response at the predetermined frequency.

9. The apparatus according to claim 6, wherein the passive energy transfer amplifier is adapted to be implanted in the body in proximity to the medical device.

10. The apparatus according to claim 9, wherein the medical device comprises a sensor for use in association with an orthopedic implant, and wherein the passive energy transfer amplifier is incorporated in the orthopedic implant.

11. The apparatus according to claim 10, wherein the sensor comprises a position sensor, which is fixed to the implant for use in assessing an alignment of the implant.

12. The apparatus according to claim 11, wherein the implant is a hip joint implant, including a femur head element and an acetabulum element, and wherein the passive energy transfer amplifier comprises a coil, which is integrated in the acetabulum element.

13. The apparatus according to claim 6, wherein the passive energy transfer amplifier is adapted to be fixed externally to the body in proximity to an area of the body into which the medical device is inserted.

14. The apparatus according to claim 13, wherein the medical device comprises a sensor, which is fixed to an invasive probe for insertion into a heart of the subject, and wherein the passive energy transfer amplifier is adapted to be fixed to a chest of the subject.

15. The apparatus according to claim 14, wherein the sensor comprises a position sensor, which is adapted to provide an indication of a location of the probe within the heart.

16. The apparatus according to claim 6, wherein the medical device comprises a sensor, which is adapted to sense a parameter within the body, and a signal transmitter, which is coupled to transmit a signal indicative of the parameter to a receiver outside the body.

17. The apparatus according to claim 16, wherein the power circuit of the wireless medical device comprises a coil antenna for receiving the electromagnetic field, and wherein the signal transmitter is coupled to transmit the signal via the coil antenna.

18. The apparatus according to claim 16, wherein the sensor comprises a position sensor, and wherein the transmitted signal is indicative of position coordinates of the medical device within the body.

19. The apparatus according to claim 18, wherein the position sensor comprises a sensor coil, and wherein the apparatus further comprises one or more field generators, which are adapted to generate energy fields in a vicinity of the medical device, which cause currents to flow in the sensor coil responsively to the position coordinates of the medical device.

20. The apparatus according to claim 16, wherein the parameter that is sensed by the sensor comprises a physiological parameter.

21. The apparatus according to claim 20, wherein the physiological parameter comprises an electrical parameter.

22. The apparatus according to claim 20, wherein the physiological parameter comprises at least one of a temperature, a pressure, a chemical parameter and a flow parameter.

23. The apparatus according to claim 6, wherein the medical device is adapted to apply at least a portion of the operating energy to tissue in the body.

24. The apparatus according to claim 23, wherein the medical device comprises an

electrode, which is adapted to apply electrical energy to the tissue.

25. Apparatus for use in an invasive medical procedure, comprising:

a wireless medical device, which is adapted to be inserted into a body of a subject, the device comprising a power circuit, which is adapted to be driven inductively by a radio-frequency (RF) electromagnetic field generated by a power transmitter outside the body, so as to provide operating energy to the device; and

a passive energy transfer amplifier, which is adapted to be placed in proximity to the medical device so as to enhance inductive driving of the power circuit of the wireless medical device by the RF electromagnetic field.

26. An orthopedic implant, comprising:

a prosthetic joint comprising first and second joint elements, which are adapted to be implanted in a body of a subject;

first and second wireless position sensors, which are respectively fixed to the first and second joint elements so as to transmit position signals indicative of an alignment of the first and second joint elements, each of the position sensors comprising a power circuit, which is adapted to be driven inductively by a radio-frequency (RF) electromagnetic field so as to provide operating energy to the sensors;

a power transmitter, which is adapted to generate the RF electromagnetic field in a vicinity of the body; and

a passive energy transfer amplifier, which is fixed to at least one of the first and second joint elements so as to enhance inductive driving of the power circuit of the wireless position sensors by the RF electromagnetic field.

27. The implant according to claim 26, wherein the prosthetic joint comprises a hip joint, and wherein the first and second joint elements comprise a femur head element and an acetabulum element, and wherein the passive energy transfer amplifier is fixed to the acetabulum element.

28. The implant according to claim 26, wherein the prosthetic joint comprises a knee joint.

29. Invasive medical apparatus, comprising:

a catheter, having a distal end, which is adapted to be inserted into a heart of a subject, the catheter comprising a wireless position sensor, fixed adjacent to the distal end of the catheter so as to transmit position signals indicative of a position of the catheter within the heart, the position sensor comprising a power circuit, which is adapted to be driven inductively by a radio-frequency (RF) electromagnetic field so as to provide operating energy to the position sensor;

a power transmitter, which is adapted to generate the RF electromagnetic field in a vicinity of the body; and

a passive energy transfer amplifier, which is adapted to be placed in a vicinity of the heart so as to enhance inductive driving of the power circuit of the wireless position sensors by the RF electromagnetic field.

30. The apparatus according to claim 29, wherein the passive energy transfer amplifier is adapted to be placed on a chest of the subject adjacent to the heart.

31. The apparatus according to claim 29, wherein the wireless position sensor comprises a sensor coil, and wherein the apparatus further comprises one or more field generators, which are adapted to generate energy fields in a vicinity of the heart, wherein the energy fields cause currents to flow in the sensor coil responsively to the position coordinates of the medical device.

32. The apparatus according to claim 29, wherein the catheter further comprises one or more electrodes for sensing electrical activity within the heart.

33. A method for driving current in a power circuit of a medical device inserted into a body of a subject, the method comprising:

generating, in a vicinity of the body, an electromagnetic field having a predetermined frequency capable of inductively driving the current in the power circuit; and

placing a passive energy transfer amplifier, having a resonant response at the frequency of the electromagnetic field, in proximity to the medical device so as to enhance the current driven in the power circuit by the electromagnetic field.

34. The method according to claim 33, wherein the passive energy transfer amplifier comprises a coil and a capacitance, which are coupled so as to define a

resonant circuit having the resonant response at the frequency of the electromagnetic field.

35. The method according to claim 33, wherein placing the passive energy transfer amplifier comprises implanting the passive energy transfer amplifier in the body in proximity to the medical device.

36. The method according to claim 35, wherein the medical device comprises a sensor for use in association with an orthopedic implant, and wherein implanting the passive energy transfer amplifier comprises incorporating the passive energy transfer amplifier in the orthopedic implant.

37. The method according to claim 36, wherein the sensor comprises a position sensor, and comprising receiving a position signal from the sensor, and assessing an alignment of the implant responsively to the position signal.

38. The method according to claim 33, wherein placing the passive energy transfer amplifier comprises fixing the passive energy transfer amplifier externally to the body in proximity to the medical device.

39. The method according to claim 38, wherein the medical device comprises a sensor, which is fixed to an invasive probe for insertion into a heart of the subject, and wherein fixing the passive energy transfer amplifier comprises fixing the passive energy transfer amplifier to a chest of the subject.

40. The method according to claim 39, wherein the sensor comprises a position sensor, and comprising receiving a position signal from the sensor, and determining a location of the probe within the heart responsively to the position signal.

41. The method according to claim 33, wherein the medical device comprises a sensor, which is adapted to sense a parameter within the body, and comprising receiving a signal transmitted by the sensor that is indicative of the parameter.

42. The method according to claim 41, wherein the sensor comprises a position sensor, and wherein the transmitted signal is indicative of position coordinates of the medical device within the body.

43. The method according to claim 42, wherein receiving the signal comprises generating energy fields in a vicinity of the medical device, which cause currents to flow in the position sensor responsively to the position coordinates of the medical device, and wherein the signal is transmitted by the sensor responsively to the currents.

44. The method according to claim 41, wherein the parameter that is sensed by the sensor comprises a physiological parameter.

45. The method according to claim 33, wherein the medical device is adapted to apply at least a portion of the operating energy to tissue in the body.